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(54) NONREFLECTING FLATTENING LAYER FOR SILICA BASE BODY

(57)Abstract:
PURPOSE: To obtain a dyed spin-on glass compsn. having a high carbon content to be used to form a nonreflecting flattening layer on a substrate such as a semiconductor silicon wafer.
CONSTITUTION: The spin-on glass compsn. contains a polyorganosiloxane polymer soln. which is crosslinked and contains an org. dye showing stable absorption of light at 350 to 500°C. The polyorganosiloxane polymer contains at least 30atm.% carbon and aminoorgano trialkoxysilane. The alkoxy groups have 1 to 4 carbon atoms. The obtd. layer can be used as a hard mask by etching according to a pattern formed on the layer. The hard mask can be used as a multilayer resist and used for the production of a lithography mask.

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CLAIMS

[Claim(s)]
[Claim 1] A dyed spin-on glass constituent which is characterized by being the dyed spin-on glass constituent containing a solution with a color of bridge formation polyorganosiloxane and optical absorption nature stable at 350-degree-C-500 degree C, for this polyorganosiloxane containing carbon of 30 atomic-weight percent, and an aminol GANOTORI alkoxy run at least, and this alkoxy group containing a carbon atom of 1-4.
[Claim 2] A hard surface mask blank to which it is the hard surface mask blank which contains a non-reflexibility flat-surface layer on a substrate, and this non-reflexibility flat-surface layer is characterized by being exposed among two or more portions of this non-reflexibility flat-surface layer to which it was guided from a spin-on glass which claim 1 dyed, and two or more places of this substrate carried out a schedule pattern.
[Claim 3] A method of manufacturing a hard surface mask blank characterized by providing the following (a) A constituent deposit step to which are the step which carries out the laminating of the silica base material layer of the shape of a non-reflexibility flat-surface layer guided from a dyeing spin-on glass constituent on a substrate, this polyorganosiloxane contains [this dyeing spin-on glass constituent] carbon of 30 atomic-weight percent, and an aminol GANOTORI alkoxy run at least including a solution of bridge formation polyorganosiloxane and optical absorption nature inorganic dye, and it was made for this alkoxy group to have a carbon atom of 1-4 (b) A step which deposits a uniform photoresist matter layer substantially on this silica base material layer (c) A step which irradiates light in the shape of a schedule pattern at two or more portions of this photoresist layer (d) A step which develops this photoresist in order to remove a portion distinguished by this optical exposure and to expose two or more portions of a lower layer silica base material layer, and a step which etches a part for this outcrop of a lower layer silica base material layer in order to expose a lower layer substrate in the shape of [same] a pattern substantially with a portion by which (e) this photoresistor strike was this irradiated

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[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the spreading liquid which gives the non-reflexibility flat-surface layer used for the photolithography processing in manufacture of a semiconductor device. Since the etch rate is smaller than an ordinary photoresistor strike, this layer functions as a hard surface mask blank for plasma etching.
[0002]
[Description of the Prior Art] The need for development of the device equipped with the multiplex metal layer has made it urgent as the request of wanting to realize a high-speed integrated circuit more increases. Utilization of the flattening matter layer for making into the minimum thickness change of the photoresistor strike matter layer which flattens the ununiformity geography on a substrate and loads it of these development on top after that is indispensable. The magnitude of a device takes the need of giving the photoresistor strike matter layer of a uniform layer, for becoming small, and it is increasing.
[0003] The geography of a lower layer substrate may cause optical interference in photolithography processing by echo of a photon. In order to prevent an echo of an exposure beam, the acid-resisting coating has been used. In order to prevent the resolution loss which originates in an echo from a substrate in this acid-resisting layer, including a color is performed conventionally.
[0004] By the conventional method, flattening and acid resisting are given by the separate layer. An organic nature flattening layer is used especially by the photolithography method. This is because a flattening layer must be able to carry out the pattern transfer of the pattern of the photoresist layer of the maximum upper layer good in a lower layer. U.S. Pat. No. 4557797 [/ else / forward-looking infrared] is indicating the activity of the poly methyl meta-KURIRATE flattening layer. U.S. Pat. No. 4621042 [/ else / loan / Pampa] is indicating the activity of alt.KURESORU novolak resin for flattening on the front face of a semiconductor. Since it is often difficult to dissolve the suitable color for an organic flattening layer, the separate layer which contained the color until now is used as an acid-resisting coating. Usually, the organic composition containing a color is used as acid-resisting paint.
[0005] Then, it is desirable to give the constituent which can manufacture the layer which achieves both flattening and optical absorption.
[0006] The spin-on glass (spin-on glass, glass which carried out revolution molding) constituent is used as a flattening layer in the case of carrying out other various processings, such as using it as an insulating layer between metal networks. This constituent is applied to a semiconductor wafer, and it rotates, and it dries and it forms a solid-state layer. Then, if this layer is hardened at an elevated temperature, it will form the layer (henceforth a silica base material layer) which uses a hard silica (the glass) as a base material.
[0007] In spite of having tried presentations various about a spin-on glass component, much limits exist in manufacture and an activity of most spin-on glass constituents. The availability as a flattening layer of these constituents should especially be restricted to breakage on the front face by processing since then, adhesive poverty, and the shortness of an inventory permissible period. The thickness limit by the

brittleness of a spin-on glass layer is also pointed out.
[0008] Another limit of the spin-on glass constituent in the case of using as a flattening layer for photoresists is that it is difficult to control the plasma etching speed of this layer. For this reason, when imprinting a pattern from the photoresistor strike layer of the maximum upper layer to a lower layer metal layer, a crevice and a deficit occur, and loss of pattern resolution is caused.
[0009]
[Problem(s) to be Solved by the Invention] Then, this invention makes it a technical problem to give the spin-on glass constituent which gives the non-reflexibility flattening layer which can be used for photolithography processing.
[0010] Another technical problem of this invention is giving the method of generating the pattern suitable for processing since then to the layer obtained from such a constituent.
[0011] Still more nearly another technical problem of this invention is giving the hard surface mask blank containing the patterned layer (patternized layer) obtained from the spin-on glass constituent of this invention.
[0012]
[Means for Solving the Problem] A spin-on glass constituent of this invention contains a polyorganosiloxane polymer solution containing organic dye which absorbs light which constructed the bridge. This polyorganosiloxane polymer contains carbon of 30 atomic-weight %, and an aminol GANOTORI alkoxy run at least. This alkoxy group has 1 thru/or 4 carbon atom.
[0013] A method of forming a patterned layer on a semiconductor substrate is also given by this invention. That this method carries out the laminating of the metallic conductor layer on a semiconductor substrate which has partial structure, and carrying out the laminating of the spin-on glass layer of sufficient thickness to give a plane non-reflecting surface substantially on this conductor layer are included. This spin-on glass layer is obtained from a constituent of this invention here. Subsequently, the laminating of the photograph REJITO material is carried out on the spin-on glass layer. Into two or more portions of this photoresist, light is irradiated, and is developed, that portion is removed, and a lower layer conductor-material portion is exposed. Subsequently, a portion to which a spin-on glass was exposed is etched and a lower layer conductor-material portion is exposed.
[0014] A hardware mask of this invention contains a substrate and a pattern of a silica base material layer obtained from a spin-on glass constituent of this invention. This base material layer is patternized by etching a part for that outcrop.
[0015]
[Example] The dyeing spin-on glass constituent of this invention is the solution of the polyorganosiloxane containing a color which constructed the bridge. This polyorganosiloxane contains the carbon and the silane fixing agent of 30 atomic-weight % at least. As a color, titanium oxide Cr 2O7 and inorganic dye like MoO4, MnO4, and ScO4 are desirable. The reason is that these stop at stability also at the temperature exceeding 90 degrees C. Organic dye becomes less stable when a spin-on glass is generally hardened at 350 degrees C thru/or 500 degrees C. The weight ratios of a color to polymer are about 0.5:1 thru/or 3.5:1.
[0016] In order to include a high carbon content into polymer, the principal chain of the polyorganosiloxane over which the bridge was constructed is guided from the mixture of an alkoxy run. the part or all -- an organic radical -- it is preferably replaced by the C1-C4-alkyl group and the phenyl group. This carbon content is determined by the number of organic substitute AKUKO xylans contained in a polymer chain.
[0017] Desirable substituents are a methyl group and a phenyl group. These substituents show high binding energy with a silica, and even if it is exposed to an elevated temperature while a spin-on glass layer hardens, they do not decompose it. An ethyl group, a propyl group, and other alkylation radicals like butyl can be adopted when [which can avoid this decomposition] it can case or ignore.
[0018] desirable -- it is and said polyorganosiloxane (henceforth bridge formation polyorganosiloxane) which constructed the bridge has both a methyl group and a phenyl group as a substituent in the example. The spin-on glass constituent which has only a phenyl group on SHIROKISAMPORIMA

gives a layer with difficult etching by the conventional etching system. As for the ratio of a methyl group pair phenyl group, it is desirable that it is in the range of 1:1 thru/or 1:3. It is most desirable that some silica atoms in the polyorganosiloxane which constructed the bridge have both the methylation radical combined with this and a phenyl substituent. This can be attained by guiding bridge formation polyorganosiloxane from a methylphenyl AKUKO xylan. Such bridge formation polyorganosiloxane gives a spreading layer with the resistance which was excellent to cracking in subsequent processing.
[0019] That an organic quantitative formula is high contributes to lowering of the amount of silanols in the bridge formation polyorganosiloxane used into the dyed spin-on glass constituent, and lowering of an alkoxy amount. The amount of silanols makes an alkoxy amount preferably less than 0.1 % of the weight less than 1.4% of the weight. The lowness of these values also originates in the bridge formation in polymer.
[0020] The carbon content of the polyorganosiloxane which constructed the bridge can be determined in heat gravity analysis (thermal gravimetric analysis). This analysis method is performed by heating the sample of fixed weight slowly within a thermal-analysis meter, and decomposing. Next, it is decided that it will be the amount of the organic substance which had the difference acquired at the beginning in the weight which remains as compared with weight lost.
[0021] A silane fixing agent is contained in the bridge formation polyorganosiloxane used for the dyeing spin-on glass constituent by this invention. These silanes are known well in the industrial world to improve the adhesiveness between inorganic data medium, such as organic resin, glass and sand, or a filler. These silane fixing agents have two molds in a substituent. One is the organic functional group coupled directly with the silicon atom, and another is the organic radical of C1-C4-aceto oxy-** combined through oxygen. It permits that alkoxy one of these / acetoxy groups include a silane into the polyorganosiloxane which constructed the bridge. As for an organic functional-group silane, it is desirable to have three C1-C4-alkoxy groups, and, as for ethoxy ****, it is [them] most desirable that it is a methoxy group.
[0022] The silane fixing agent marketed is an amino organic organic-functions group, an ureido organic functional group, or a glycide oxy-organic functional-group group. An aminol GANOTORI (C1-C4) alkoxy run is desirable. as the example -- gamma-aminopropyl-TORIE -- an ibis -- a silane, a gamma-aminopropyl trimethoxy run, and N-beta (aminoethyl)-gamma-aminopropyl TORIE -- an ibis -- there are a silane and an N-beta (aminoethyl)-N-beta (aminoethyl)-gamma-aminopropyl trimethoxy run. the most desirable organic functional-group silane fixing agent -- gamma-aminopropyl TORIE -- an ibis -- it is a silane.
[0023] An aminol GANOTORI (C1-C4) alkoxy run has the desirable thing of the polyorganosiloxane which constructed the bridge included about 10 to 50% of the weight. Content of this level gives remarkable bridge formation. In this way, the feature of the polymer obtained is the polyorgano silsesquioxane (polysilsesquioxane) polymer resulting from bridge formation-ization. The bridge formation organopolysiloxane used for the spin-on glass constituent of this invention can have KONSHI stent structure with the "cube octamer (cubical octamer)" structure, the duplex chain "ladder (ladder)" structure, or its both. others [Barry / A JIE] -- "inorganic polymer" (a stone and the Graham edit, New York State Academic Press, the 1962 issuance, 195 pages) -- such structures are explained to Chapter 5. These are having complicated structure originating in the 3 functional-group nature of a thoria RUKOKI silane which has the organic group of one ** in each silicon atom. Although a tetra-alkoxy run and a JIORUGANO alkoxy run can be included in these polymer, polymer is guided from most portion and a 3 organic-functions silane.
[0024] The weight average molecular weight of the bridge formation polyorganosiloxane polymer used for the dyeing spin-on glass constituent of this invention is about 2000 thru/or about 20000 or more ranges. The only limit about polymer molecular weight is that the viscosity of the solution formed in order to allow uniform spreading polymer must be able to dissolve in an inactive organic solvent must fully be low.
[0025] They are a solution-like, as for the polyorganosiloxane and the color which constructed the bridge in the spin-on glass constituent which this invention dyed, it is desirable that the weight ratios of

the total amount of solid-states are concentration 5 thru/or 40 % of the weight, and it is most desirable that they are 5 thru/or 20 % of the weight. Mono-hide rucksack alcohol, poly hide rucksack alcohol, and glycol ether are contained in a suitable solvent. Next, what is hung up is the example of suitable mono-hide rucksack alcohol. 1-butanol, 2-butanol, 2-methyl-1-propanol, a 2-methyl-2-propanol, and 1-phenol. Suitable poly hide rucksack alcohol and oligo MERIKKU alcohol are the ethylene GURIKORU monoethyl ether, the diethylene GURIKORU monoethyl ether, TORIECHIRENGURIKORUMONO ethyl ether propylene GURIKORUMONO ethyl ether, Zypro pyrene GURIKORUMONO ethyl ether, and Zypro pyrene GURIKORUMONO methyl ether. The mixture of these alcohol is also suitable. These alcohols are also suitable. In order to dry, the inactive organic solvent should have less than 250 degrees C and the desirable boiling point higher than 80 degrees C. The activity of N-butanol and isopropyl is desirable.

[0026] the spin-on glass constituent which this invention dyed -- a hydrogen ion exponent -- the range of 3 thru/or 7 -- it is in the range of 6 thru/or 6.7 preferably. An acid hydrogen ion exponent is given with an organic acid or a hydrogen peroxide. A desirable acid is an acetic acid. As for the viscosity of the dyed spin-on glass constituent, it is desirable at the time of 5 thru/or 20% of the weight of solid-state content that it is in the range of about 3.5 thru/or 9 centistokes. When viscosity is too low, multiplex spreading is needed in order to obtain a thick spin-on glass layer. If viscosity is too high, it will become difficult to attain uniformity, in case a substrate is applied.

[0027] The dyeing spin-on glass constituent of this invention is stable. That is, viscosity does not increase under ambient temperature over one years or more.

[0028] The above-mentioned spin-on glass constituent by this invention is prepared by dissolving the polyorganosiloxane which contains at least 30% of the weight of carbon in an organic solvent. This solvent is desirable and the boiling point is less than 250 degrees C, desirable mono-hide rucksack alcohol higher than 80 degrees C, poly hide rucksack alcohol, or glycol ether. A suitable solvent kind is the above-mentioned thing. N-butanol and isopropyl alcohol are desirable.

[0029] The polyorganosiloxane with a high carbon content is obtained by KOHIDORO-izing the mixture of alkoxy runs. By the organic radical, it is a C1-C4-alkyl group and a phenyl group preferably, and some of ARUKOKISORAN or all is replaced. As a precursor of the polymer in the spin-on glass constituent of this invention, such polyorganosiloxanes contain the methyl and the phenyl substitution product of request level. Therefore, as for the ratio of methyl pair phenyl, in the above-mentioned bridge formation polyorganosiloxane, it is desirable that it is the range of 1:1 thru/or 1:3. Furthermore, such polyorganosiloxanes contain the silicon atom which both methyl and a phenyl group combined.

[0030] Linearity is sufficient as the polyorganosiloxane used for the method of this invention, and as long as it can stop at poly silsesquioxane polymer, it may have the remarkable number of bridge formation. As long as they can be dissolved in an inactive organic solvent, there is no limit about structure and molecular weight.

[0031] Two or more polyorganosiloxanes can be used in the method of this invention of giving a spin-on glass constituent. However, it is desirable not to use mixture, in order to guarantee consistency structure.

[0032] this polyorganosiloxane -- carrying out -- no, ******** is low. Since this has the high amount of organic components, it is because the degree of cross linking is high depending on the case. A silanol content is less than 13 % of the weight, and it is preferably desirable for an AKUKOKISHI content to be less than 10 % of the weight.

[0033] The carbon content in a desirable poly methylphenyl siloxane is the range of about 40 to 50 atomic-weight %. However, polyorganosiloxane with a higher carbon content is also suitable.

[0034] the dissolved polyorganosiloxane -- the bottom of a bitter taste potash condition -- setting -- a silane fixing agent -- desirable -- an aminol GANOTORI-(C1-C4)-alkoxy run -- most -- desirable -- gamma-aminopropyl-TORIE -- an ibis -- it reacts with a silane. An aminol GANOTORI (C1-C4) alkoxy run does not need to add a base material in a solution, and is fully alkalinity. When it is non-alkalinity, in order that this silane fixing agent may promote a reaction, introducing an volatile organic amine is expected. As for the hydrogen ion exponent of this reaction data medium, it is desirable that it is nine or

more.
[0035] The amount of this polyorganosiloxane and the silane fixing agent which reacts can reach far and wide dramatically. However, it is desirable to make the weight ratio of a silane to polyorganosiloxane into the range of 0.11:1 thru/or 1:1.
[0036] The hydrogen ion exponent of above-mentioned reaction data medium is decreased [to slow down a reaction] to stagnate at the time. It depends for reaction time on a reaction rate. A reaction rate is influenced with temperature and a pressure. The reaction which advances at a room temperature for 2 hours or more is effective in generation of a spin-on glass constituent.
[0037] a reaction is fallen substantially -- making -- a hydrogen ion exponent -- less than seven -- however, it should carry out to 3.0 or more, and if it carries out like this, hydronalium-ization which makes an acid a catalyst will progress. The ranges of a desirable hydrogen ion exponent are 5 thru/or about 7, and are 6 thru/or 6.7 most preferably. This can be attained by adding organic acids, such as an acetic acid or a hydrogen peroxide. The activity of an acetic acid is desirable.
[0038] Once a reaction is suspended, it is desirable to ripe the constituent concerned for about one week preferably before an activity. Moreover, it is desirable to remove all the precipitate that filtered the solution with submicron filters, such as a 0.2-micron Teflon filter, and was formed during the reaction. If it carries out like this, this constituent will stop at the period of one year or more, and stability after that.
[0039] Before performing a reaction with a fixing agent, it can add in a solution, and a color can be added after an organic acid or a hydrogen peroxide.
[0040] The spin-on glass constituent which this invention dyed can be applied to a substrate with the conventional spin spreading technology, and it rotates by 1000 or more rpm so that a substrate (wafer) may produce the uniform layer of a spin-on glass constituent in that case. The well-known methods of arbitration including the spin method, a roller-coating method, the immersion-raising method, a spray method, screen printing, and the method of the brush method and others can be used suitably. as a suitable substrate -- a semiconductor, a silicon wafer, a glass plate, a metal plate, and others -- there is a thing similar to this.
[0041] The thickness of a layer can be changed by changing the viscosity of this spin-on glass constituent. The non-reflexibility flattening layer which exceeds 500A by multiplex spreading can be obtained. Subsequently to about 200 degrees C a spin-on glass constituent heats a wafer, and is dried. After a spreading layer is dried, the applied substrate is heated to about 350-degree-C temperature of -500 degree C, stiffens a spin-on glass spreading layer, and forms a smooth non-reflexibility flattening layer. When it once dries, as for the dyed spin-on glass constituent, it is desirable that shrinkage characteristics are small. Although about 15% of contraction is permissible in the vertical (vertical) direction, it is desirable to suppress contraction to about 10% or less. this -- a book -- it is easily obtained in the desirable example.
[0042] The dyeing spin glass constituent of this invention can give a non-reflexibility flattening layer 5000A or more, without being able to give a non-reflexibility flattening layer 500A or more, and cracking or a deficit in subsequent processing.
[0043] The non-reflexibility flattening layer given with the dyeing spin-on glass constituent of this invention shows the very strong resistance over oxygen, also while etching by CHF3 and O2. This resistance is remarkable especially when the polyorganosiloxane which constructed the bridge contains many phenyl groups.
[0044] The dyeing spin-on glass constituent of this invention gives the hard surface mask blank which can be patternized again by carrying out plasma etching of the schedule field of this constituent layer. These hard surface mask blanks can form a part of multiplex resist for patternizing lower layers, such as a conductive layer. Moreover, these layers can also be given on a transparence substrate as preparation which gives a RITOGURAFIKKU mask.
[0045] The multiplex layer resist arranged on one layer which should be patternized is made only with the hard surface mask blank and photoresist layer chisel which are given with this dyeing spin-on glass constituent. It is desirable to place an interlayer between a hard surface mask blank and its lower layer or

between photoresist matter. Another spin-on glass constituent is suitable for an interlayer.
[0046] A hard surface mask blank is obtained by first carrying out the laminating of the silica base material layer guided from the dyeing spin-on glass constituent of this invention on a base. As for this layer, it is desirable to have a flat top front face substantially. The laminating of the layer of the uniform photoresist matter is substantially carried out on this silica base material layer. Subsequently to, this photoresist can irradiate light in the shape of a schedule pattern, and it is developed in order to remove that portion and to expose a lower layer silica base material layer. Subsequently, a part for the outcrop of this silica base material layer is etched with the plasma until a lower layer substrate is exposed to the shape of a pattern of said schedule pattern and real isomorphism formed in the photoresist.
[0047] The exposed region of a lower layer substrate can be carried out if processing of etching etc. is subsequently still more nearly required. If processing is completed, a hard surface mask blank will be removed by etching with O2 plasma, when typical. Since a silica base material layer is resistant to etching and the speed of etching can be controlled, pattern deficits are merely few.
[0048] The example of example 1 dyeing spin-on glass constituent dissolved 52g poly methylphenyl siloxane polymer in 800ml N-butanol. This polymer came to hand by the solid-state piece from Illinois Owen. The amounts of silanols of polymer were about 13 % of the weight thru/or 14 % of the weight, and the amount of ethoxy was about 8 % of the weight. Having been more than 40 atomic-weight % was determined in the heat gravimeter analysis of an initial sample. In this analysis, after the sample measured weight, it was heated to 600 degrees C at a rate of 2 degrees C/m, and it was cooled at the same speed to ambient temperature. The amount of residuals was measured after cooling and loss weight was determined as the carbon content. Although the aluminum oxide of a certain amount was heated with the resin sample, it was shown by heat gravimeter analysis that there is neither weight loss nor

[0049] Polyorganosiloxane was dissolved in N butanol within 30 minutes. then, 7.2ml gamma-aminopropyl TORIE -- an ibis -- while the silane agitated within 1 minute, it was added with the pipet. It carried out and the run was distilled from the silane solution currently sold with the mark of A1100 from Union Carbide. This solution was maintained at the constant temperature in a reaction period (23 degrees C). This solution continued being agitated for about 8 hours, and the 7.0ml acetic acid (electronic grade) was added after that. Precipitate was formed into the solution.
[0050] The hydrogen ion exponent fell to about 6.5 after acetic-acid addition. About 40g Ti (IV) butoxide was added by this solution. This Ti changes to TiO2 in a solution. This solution riped for one week, was filtered to 0.2 microns with the Teflon filter after that, and removed precipitate. The solid-state concentration of this solution was about 6 % of the weight, and viscosity was about 4 centistokes. The silanol content was about 1.5% and the alkoxy content of the generated poly methylphenyl silsesquioxane polymer was less than 0.1%.
[0051] Spin-on glass layer: About 1g solution was applied to the silicon wafer with a diameter of 4 inches. This wafer rotated for about 3 seconds by speed 1000rp0m on the spinner, and, subsequently rotated by 4500rpm for about 30 seconds. A constituent has neither formation of foam, nor bulging, and has applied the wafer uniformly. Subsequently, this wafer was moved to the ellipsomter (Ellipsometer) and thickness and a refractive index were determined by several places of a wafer. The refractive index was the average 1.5 [about] as a typical value, and average thickness was about 1500A. Following this measurement, the wafer was moved to the hot plate and heated by about 200 degrees C for about 1 minute for spreading layer desiccation. The thickness and the refractive index of a spreading layer were again measured by the ellipsomter, and contraction of the vertical (vertical) direction was calculated. Less than about 10% of this was typical.
[0052] Multiplex layer spreading was repeated until it made it total thickness and became 4000 thru/or the range of 10000A.
[0053] When desired thickness was obtained, the wafer was moved to the tubular furnace and heated by about 400 degrees C in nitrogen-gas-atmosphere mind for 60 minutes. Subsequently, the center of a wafer was measured by the ellipsomter, the refractive index of a wafer was measured, and thickness was measured by nine places. Let the averages of these values be spreading layer thickness and a refractive

index. As for a refractive index, about 1.49 is representation ****. It suited within the limits of 4000 thru/or 9000A. The cracking crack or the pinhole were not detected at all by the spreading layer. A spreading layer has the almost same etch rate as the film containing the same SHIROKISAMPORIMA without a color. The etching method performed in such a spin-on glass layer is illustrated below.
[0054] The etching method: What does not contain a color with the silica base material film prepared by the above-mentioned method was etched by CHF3 and O2 within AME8110 "a rear KUEIBU ion etcher" of an applied material company. The etch rate of these films is almost the same as that of the case of the film containing a color. The oxygen volume flow rate was changed and the etch rate was determined about many samples. The etch rate of the silica base material film obtained from the spin-on glass constituent (color content is not carried out) of two marketing also changed the oxygen volume flow rate, and was determined. These results are summarized to the following tables.
[0055]
table 1 Etch rate (a part for angstrom/)
---------------------------------- O2 volume flow rate This example * ACC1 108 ACC2 110 SCCM (300 degrees C) (425 degrees C) (425 degrees C)
---------------------------------- 4 150 5 120 175 6 60 7 190 225 8 75 9280 350 10 110 13 160 15 220 17 225 ---------------------------------- Note 1 Acc 108 = color Accuglass 108 (ARAIDO chemical company) which is not contained
notes 2 Accuglass 110 (ARAIDO chemical company) which does not contain an Acc 110 = color
* This film does not contain a color.
[0056] The data of a table 1 shows that it has high resistance even if it changes an oxygen density variously, when the silica base material layer manufactured with the constituent of this invention etches by CHF3.

[Translation done.]